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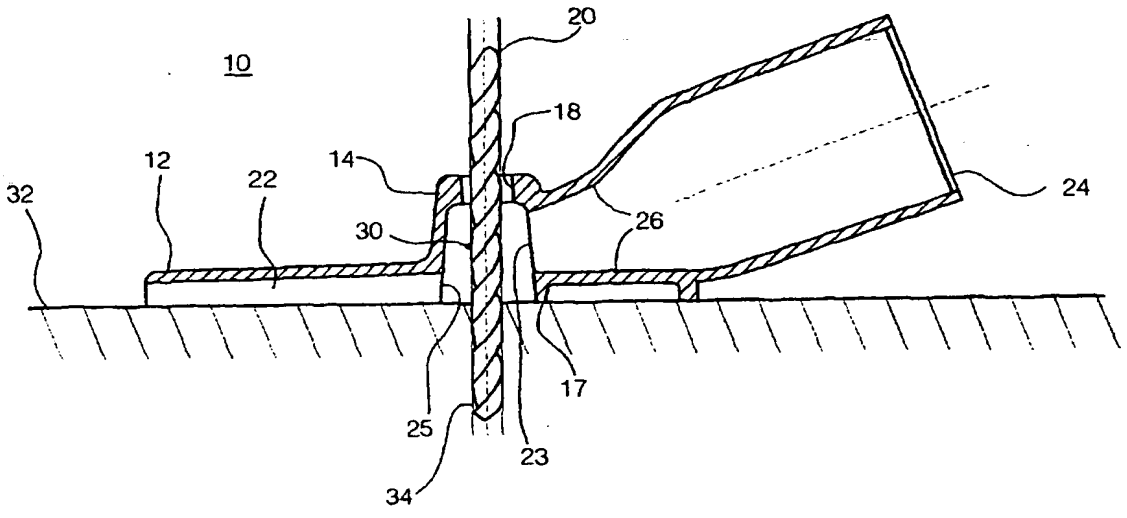
(54) Title: A DUST COLLECTION DEVICE



(57) Abstract: A dust collection device (10) comprises a housing (12) which defines a chamber (14). A first aperture (17) is adapted to lie against a surface (32) to be drilled. A second aperture (18) is opposite the first aperture and between them defines a chamber axis (19). A drill bit (not shown) is adapted to pass through the apertures (17, 18) to drill the surface (32). A third, outlet, aperture (23) is elongate and at its distal end (24) is adapted for connection to a vacuum hose (16) of a domestic vacuum cleaner. A fourth, inlet, aperture (25) is formed in the chamber (14) to permit inflow of air into the chamber (14) in response to vacuum from the vacuum source. The inlet aperture (25) extends radially outwardly (22). A fluid passage is defined by the inlet (22). A fluid passage is defined by the inlet (22), inlet aperture (25), chamber (14) (forming a dust collection zone (30) around a drill bit (not shown)), outlet aperture (23) and outlet (24). The fluid passage does not decrease in cross sectional area in the direction of air flow.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A Dust Collection Device

This invention relates to a dust collection device and in particular to a device for the collection of dust produced during drilling.

It is known that the drilling of holes into walls and other surfaces produces unwanted dust and debris. With the increase in do-it-yourself (DIY) activity more and more people are using drills within the home, quite often in fully furnished rooms. Where drilling results in the unwanted dust radiating away from the drill site then this can be problematical and cleaning up afterwards can be very time consuming.

This is especially so when the surface being drilled is a substantially vertical wall, where the bulk of the debris tends to billow out and fall in an area radiating away from the drill site. The dust often settles on skirting boards, carpets and wall coverings. Subsequent attempts to remove this dust can be extremely difficult. In instances where brick dust is involved it may not be possible to clean the surrounding furnishings completely, permanent and unsightly staining can result, especially in the case of wall coverings being so contaminated.

Prior art solutions to this problem include a device, for use during drilling, which is intended to catch the dust and stop it from falling to the floor. This invention is disclosed in GB 2 278 190 A. A substantially annular cup-type device is employed, which is held against the wall during drilling, the drill bit

passing through the centre of the annulus. When drilling is complete the drill is first removed from the surface being drilled, and then the catching device is removed. However, there are several problems with this solution such as: airborne dust by-passing the drill and escaping from the centre of the annulus; and some of the dust collected by the cup being dropped during the removal process, leading to a trail of dust being deposited around and leading from the drill site.

A second prior art solution, disclosed in GB 2 257 247 A, involves the employment of a device that is connected to a vacuum pump, such as a domestic vacuum cleaner, where it is intended that the dust be vacuumed away as it is produced, thus obviating some of the above difficulties.

The device comprises a cylindrical housing which is closed at one end and connected to a source of vacuum at the other end. Two diametrically opposite openings are incorporated in the circumferential surface adjacent to the closed end, one opening being engaged by a substantially cup-shaped insert which is intended to engage with the surface to be drilled, and which will contain the dust produced by drilling. It is intended that the dust so collected be continuously transported away from the drill site by means of the vacuum created within the housing. The second opening is provided with a multiplicity of outwardly radiating slits, the inner ends of which accommodate, engage with and to a certain extent provide a partial seal around, a drill bit, which is to be used during drilling.

However, there are problems with this solution, the most significant of which is the absence of any externally connecting openings, either at the insert or in the vicinity around the drill. In consequence, a partial vacuum will be produced within the housing which will draw the cup-shaped insert into closer contact with the surface being drilled, but there will be little or no actual air flow available for use in the transportation of dust and debris away from the drill site as intended.

A third prior art solution, disclosed in GB 2 012 043 A, includes a cup, which is provided with an aperture for accepting a drill bit, and a length of tubing leading from the interior of the cup and connectable at its other end to a vacuum cleaning suction inlet. The side of the cup is provided with an air hole and also an outlet hole. The purpose of the air hole is to promote a flow of air into the cup to aid removal of the dust produced by drilling. The purpose of the outlet hole is to facilitate the extraction and transportation of dust, via the length of tubing, to the vacuum cleaner.

A fourth prior art solution, GB 2 335 032 A, employs a flexible cup with an inner core which is provided to prevent substantially full collapse of the housing. The inner core of the device is provided with one or more apertures, arranged to allow a flow of air down the inner core, the intended purpose of this air being to minimise the loss of dust or debris via the aperture through which the drill bit is inserted during use.

Several problems arise with both these solutions, the most significant being the limited capability of the suction produced by the vacuum cleaner to actually transport the dust, produced by drilling, away from the drill site. The only effective means of vacuuming dust away from the drill site is through the creation of air flow. If the air does not flow then neither will the dust.

It can be readily appreciated that prior art solutions that include a substantially annular cup-type device, the housing of which is arranged such that actuation of a vacuum pump results in attachment of the housing to a surface by suction such as in GB 2 257 247 A, will not encourage air to flow.

Further, it is known that fine brick dust can be held in suspension and transported in air, but only when the air is not unduly pressurised and is flowing with sufficient speed such as to impart the necessary energy to each dust particle in order to counteract the effects of gravity. Indeed, the phenomenon known as the Venturi effect results in air which is moving in a restricted passageway to experience a drop in pressure. It is this pressure drop, sometimes referred to as 'negative pressure', which creates the condition that allows fine dust particles deposited into the passageway, to become airborne.

Of course the reverse is also true. In devices that incorporate relatively large enclosures, with restrictive apertures on both sides i.e. both upstream and downstream

of the air flowing through the enclosure, the air will slow down dramatically as it progresses from the aperture into and through the voluminous enclosure. In consequence, the air in the enclosure will be at a relatively higher pressure than in the adjacent apertures. This pressurised, slow moving air will not transport brick dust and other debris, effectively. High suction will not, in itself, result in the airflow required to transport dust. Moreover, this dust transportation capability is not significantly influenced by the actual volume of air being moved.

It is an object of the present invention to overcome the aforementioned difficulties and provide an improved dust collecting device. It is a further object of the present invention to produce a device that enables drilling of walls and other surfaces, whereby 'negative pressure' air flow is used to transport the resulting dust and debris away from the drill site.

According to the present invention there is provided a dust collection device comprising: a housing defining a chamber; a first aperture in the housing adapted to lie against a surface to be drilled; a second aperture in the housing opposite the first and between them defining a chamber axis along which a drill bit to drill said surface is adapted to pass; a third, outlet, aperture in the housing adapted for connection to a vacuum source; and a fourth, inlet, aperture in the housing to allow ingress of air into the chamber in response to vacuum in the chamber caused by said vacuum source; whereby, in use, a fluid passage is created for air flow comprising,

in order, said inlet aperture, said chamber around a drill bit, and said outlet aperture, characterised in that, the cross sectional area of said fluid passage, transverse to the direction of air flow, does not decrease in the direction of said air flow. Preferably, it increases gradually in said direction.

Accordingly, given a specific pressure difference across the entire fluid passage, with a cross section that does not decrease to any significant extent in the direction from high pressure to low pressure, there will be no areas of relatively high pressure in the passage resulting in deceleration of the airflow. Instead there will be a relatively constant airflow speed through the device. This means that dust picked up by the airflow should not be deposited anywhere within the device, but will be carried in the airflow out of the device.

Said fourth aperture may comprise one or more holes in said housing. Alternatively said fourth aperture may comprise, in use, an annulus defined between a drill bit passing through said second aperture and the second aperture. However, preferably, said first aperture comprises an annular lip and said fourth aperture comprises an inset in said lip adapted to create an opening between said surface and lip at the edge of said first aperture.

Preferably said chamber between said first and second apertures is substantially cylindrical or frusto-conical about said chamber axis.

Preferably, said fourth, inlet, aperture is, in use, nearer said surface than said third, outlet, aperture. Thus, air moving through said chamber moves in a direction away from the surface being drilled, before entering the outlet aperture.

Preferably, within a typical range of sizes of drill bit which can be accommodated by the device, said cross sectional area increases progressively so as to maintain a constant air speed through the device, thereby optimising the dust carrying ability of the system. Indeed, the cross sectional area of the chamber transverse to the direction of air flow is preferably less than 800mm^2, more preferably less than 400 mm^2, ideally less than 200mm^2.

Preferably said fourth, inlet, aperture is at the end of an elongate passage. The passage preferably has a cross section, transverse the direction of air flow, which increases in the direction of air flow. However, it is the dimension of the aperture where it opens into the chamber that is important, and, without departing from the present invention, said passage could also have a diminishing cross-section in the direction of airflow to accelerate air into the chamber.

The third, outlet, aperture preferably also leads into an elongate passage and expands in the direction of air flow to permit connection of a flexible hose of a domestic vacuum cleaner.

Preferably there are more than one fourth aperture provided, evenly spaced around said chamber axis. Indeed, there may be three of said elongate fourth apertures radiating outwardly from said chamber, said elongate third aperture extending from above and between two of said fourth apertures.

Preferably, said housing is transparent, to permit accurate alignment of a drill bit point with a selected location of a hole to be drilled.

Preferably, the entire device is formed from plastics material.

A dust collection device embodying the present invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

figure 1 is a perspective view of the device from above.

figure 2 is a perspective view of the underside of the device.

figure 3 is a sectioned elevation showing communicating apertures and zones within the housing

figure 4 is a second sectional elevation showing a drill bit in position, as it would be in normal use during the drilling of a hole.

With reference to Figures 3 and 4 there is illustrated a dust collection device 10 comprising a housing 12 which is generally triangular when seen in plan view, with a centrally disposed enclosure 14, an

outlet 24 which also provides the means for attaching the device to a vacuum pump hose 16, and an aperture 18 for the insertion of a drill bit 20 when the device is in use. Situate within enclosure 14 is a dust collection zone 30, which is formed between the inside walls of enclosure 14, and the surface being drilled 32. When inserted, the drill bit 20 lies in substantial alignment with the central axis of the substantially tubular dust collection zone 30. Air inlet apertures 22 in the form of extended passageways, communicate with the dust collection zone 30, and deliver fast flowing, low-pressure air from the perimeter of the housing 12 into zone 30 and thence by outlet 24 to the vacuum pump.

The outlet 24 is substantially cylindrical, and tapers towards its inner end 26 where it converges with the housing 12 at an angle 28. The outlet 24 along with the vacuum cleaner nozzle 16 is used to support the device during use. The angle 28 helps to ensure that the user's hand is to one side of the device 10, allowing the user to maintain line of sight, both when inserting the drill 20 through the drill bit aperture 18 and also whilst drilling holes.

The device 10 is transparent and is preferably formed from a resilient plastics material. Equally, it could be solid in colour for aesthetic reasons.

The zones and passageways are arranged such that when the device is presented close up to the surface to be drilled 32, and a drill bit 20 is inserted through into the housing 12 via aperture 18, rotation of the

drill bit 20 will result in dust, emanating from the hole being drilled 34, being deposited in the above mentioned collection zone.

Actuation of a vacuum pump results in the dust so deposited, being picked up by the air flowing in from the one or more air inlet apertures 22, being carried away from the drilling site, and thereafter being transported via the communicating outlet 26 toward the vacuum cleaner.

The air inlet passageways 22, the dust collection zone 30 within the enclosure 14, and the outlet passage 26 are arranged with a controlled and progressive increase in cross sectional area normal to the direction of air flow, so that changes in area are minimised, air flow is at a constant speed and pressure gradient, and dust is efficiently collected and transported through the device.

CLAIMS

1. A dust collection device comprising:

a housing defining a chamber;

a first aperture in the housing adapted to lie against a surface to be drilled;

a second aperture in the housing opposite the first and between them defining a chamber axis along which a drill bit to drill said surface is adapted to pass;

a third, outlet, aperture in the housing adapted for connection to a vacuum source; and

a fourth, inlet, aperture in the housing to allow ingress of air into the chamber in response to vacuum in the chamber caused by said vacuum source,

whereby, in use, a fluid passage is created for air flow comprising, in order, said inlet aperture, said chamber around a drill bit, and said outlet aperture,

characterised in that, in use, the cross sectional area of said fluid passage, transverse to the direction of air flow, does not decrease in the direction of air flow.

2. A device as claimed in claim 1, wherein said fourth aperture comprises one or more holes in said housing.

3. A device as claimed in claim 1, wherein said fourth aperture comprises, in use, an annulus defined between a drill bit passing through said second aperture and the second aperture.

4. A device as claimed in claim 1, wherein said first aperture comprises an annular lip and said fourth aperture comprises an inset in said lip adapted to create an opening between said surface and lip at the edge of said first aperture.

5. A device as claimed in any preceding claim, wherein said chamber between said first and second apertures is substantially cylindrical or frusto-conical about said chamber axis.

6. A device as claimed in any preceding claim (except claim 3), wherein said fourth, inlet, aperture is, in use, nearer said surface than said third, outlet, aperture.

7. A device as claimed in any preceding claim, wherein the cross sectional area of the chamber is less than 800 mm^2, preferably less than 400 mm^2, and ideally less than 200 mm^2.

8. A device as claimed in any preceding claim (except claim 3), wherein said fourth, inlet, aperture is at the end of an elongate passage.

9. A device as claimed in claim 8, wherein said passage has a cross section transverse to the direction of air flow, which cross section increases in area in the direction of air flow.

10. A device as claimed in any preceding claim, wherein said third, outlet, aperture opens into an elongate outlet passage that expands in cross sectional area in the direction of flow to permit connection of a flexible hose of a domestic vacuum cleaner.

11. A device as claimed in any preceding claim (except claim 3), wherein more than one fourth aperture is provided, evenly spaced around said chamber access.

12. A device as claimed in claims 10 and 11, when dependent on claim 8 or 9, wherein there are three of said fourth apertures and elongate passages radiating outwardly from said chamber, said third aperture and elongate outlet passage extending from above and between two of said fourth apertures.

13. A device as claimed in any preceding claim, wherein said housing is transparent.

14. A device as claimed in any preceding claim, wherein said housing is formed from a plastics material.

15. A dust collection device substantially as hereinbefore described with reference to the accompanying drawings.

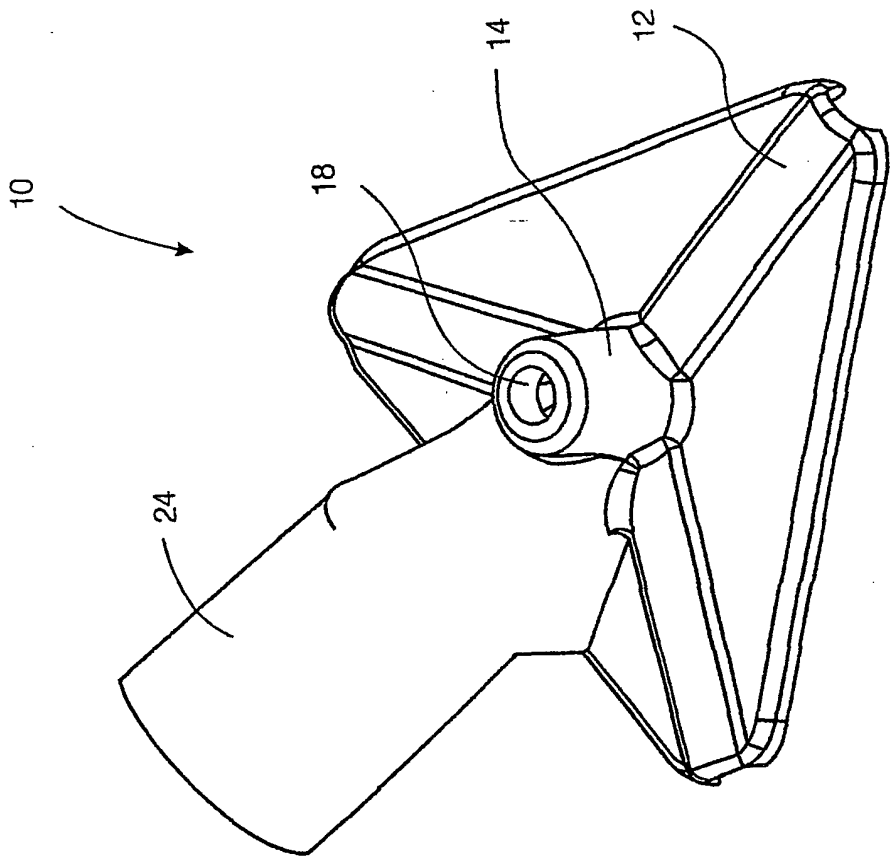

Fig. 1

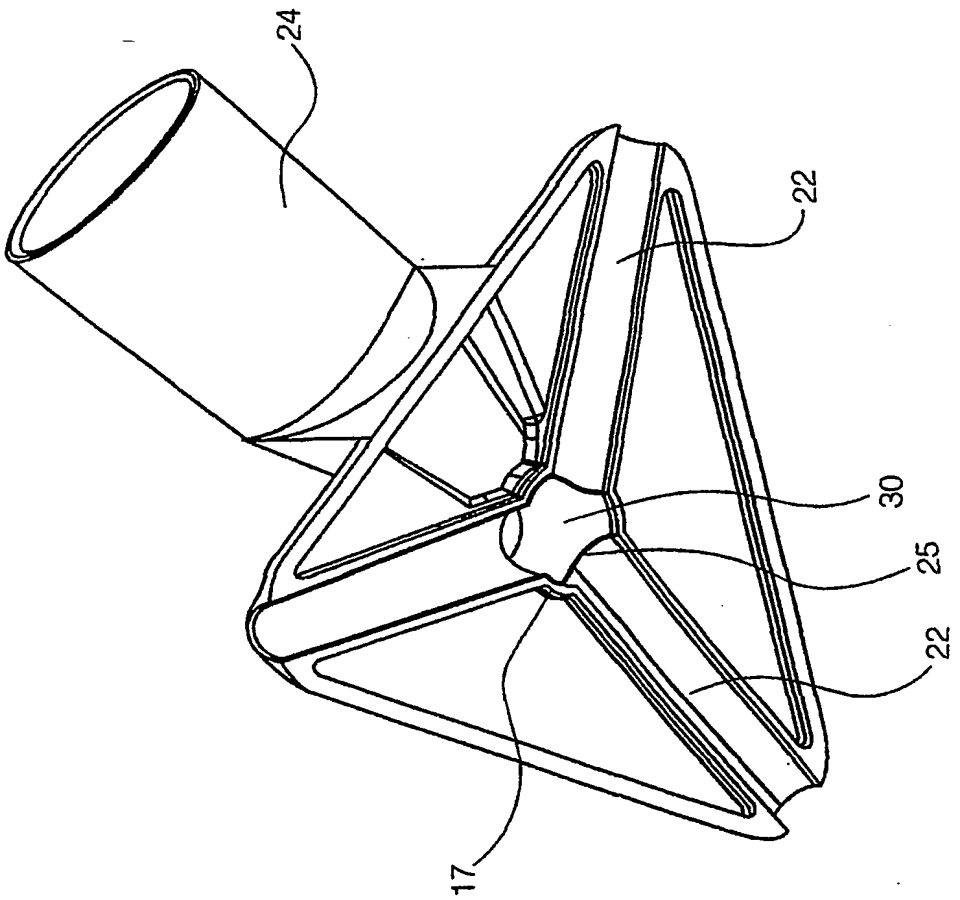

Fig. 2

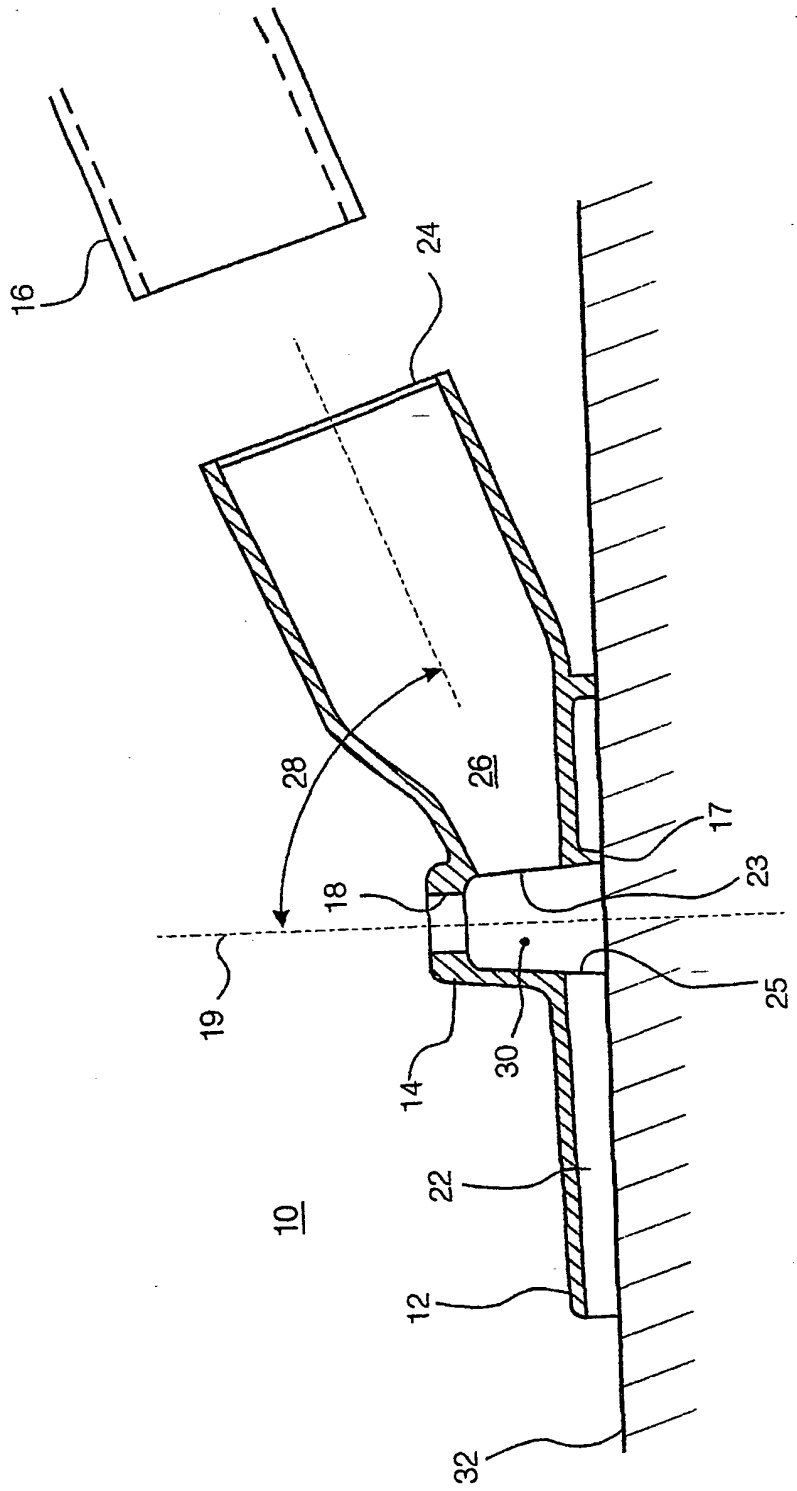

Fig. 3

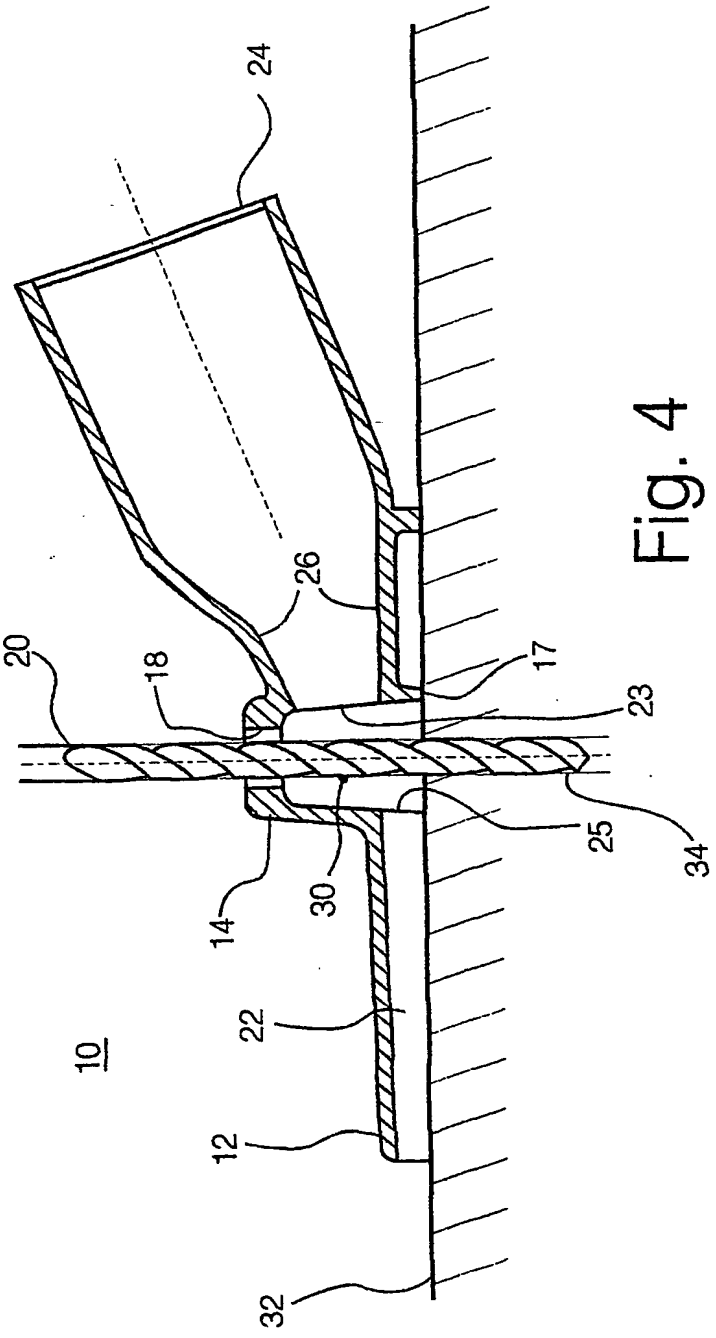

Fig. 4

INTERNATIONAL SEARCH REPORT

Interna ıal Application No
PCT/GB 01/03874

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B23Q11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B23Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 40 38 941 A (HILTI AG) 11 June 1992 (1992-06-11)	1,2,4-6, 10-12
A	column 3, line 19 - line 68; figures 1-3	7-9
A	GB 1 463 796 A (HIRDES R) 9 February 1977 (1977-02-09) page 3, line 104 -page 4, line 68; figures 1,2	3,13,15
A	US 4 184 226 A (LOEVENICH NORBERT) 22 January 1980 (1980-01-22) column 4-10; figures 5-7	3,5,8, 10,13-15
A	DE 37 34 127 A (FESTO KG) 20 April 1989 (1989-04-20) figures 1,2	4,8,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kornmeier, M

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INTERNATIONAL SEARCH REPORT

ormation on patent family members

Inter nal Application No
PCT/GB 01/03874

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